maintenance, and systems integration services. To support these services, U S WEST has entered into alliances with Qwest and Williams Communications to build an intercity data transport network (the !nterACT network) that will cover the top 80 markets outside its region. This network will enable U S WEST to provide its customers with end-to-end solutions for all their data transport needs, and to guarantee the quality of its network services. Together, these activities confirm that U S WEST is willing and able to deploy the advanced communications and information services that Congress hoped to bring to "all Americans" and to "all regions of the Nation" by passing the Telecommunications Act.

High-Speed Data Networks and Smaller Communities

Smaller communities currently face an acute shortage of data bandwidth, especially (but not exclusively) the Transmission Control Protocol/Internet Protocol (TCP/IP) facilities that make up the "internet backbone" — the highest levels of the hierarchy of networks that collectively make up the internet.[3/] At the bottom are the millions of individual and corporate customers who subscribe to the retail access offerings of the thousands of ISPs nationwide.[4/] For the most part, these retail customers connect to their ISPs through dial-up

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[3/] In light of the Commission's particular concern with ensuring that rural communities can connect to the "information superhighway," this discussion focuses on the scarce deployment of TCP/IP networks (i.e., internet backbone) in these areas. Section 706, however, directs the Commission to advance the deployment of "advanced telecommunications capability" more broadly, and is not limited to TCP/IP networks. The pace of deployment of these other data technologies (cell-switched and packet-switched networks) in rural communities likewise lags behind deployment in their urban counterparts, and for similar reasons.

[4/] As shown in the illustration, there are actually several tiers of ISPs. In addition to serving retail end users directly, many large ISPs wholesale internet transit services to smaller

(continued...)

access over the circuit-switched voice network or, for many corporate customers, via private lines. (Faster means of connecting, such as megabit-speed digital subscriber lines, are rapidly becoming available, and one aim of this petition is to accelerate the deployment of these high-bandwidth connections.) Each ISP, in turn, routes its subscribers' data traffic upward in the hierarchy to the network of a regional or national backbone provider, using a leased line that connects to the modem banks and routers that make up the backbone provider's local point of presence, or "PoP." The backbone provider carries this traffic between the nodes of its network on high-speed lines (with the fastest lines connecting the largest nodes of the network) and, if necessary, exchanges the traffic with other backbone providers at high-capacity internet exchange points. The traffic is then routed downward through the hierarchy to its destination.

The facilities that make up the internet backbone are not evenly distributed across the country. The high-speed links of the network — DS-3 links (45 megabits per second) and above — connect only the largest cities, leaving smaller communities behind. Illustrations 1-7 demonstrate this problem vividly.[5/] These maps show, for each of the largest backbone networks (PSINet, GTE/BBN, WorldCom, MCI, Digex, Sprint, and AT&T), which cities are connected to the internet with high-capacity (DS-3 or faster) PoPs.[6/] At best, each network has only a handful

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[4/] (...continued)
ISPs, who in turn sell internet access to end users.

[5/] This information is drawn from Boardwatch Magazine's February 1998 survey of TCP/IP backbones that are national in scope, peer at the major Network Access Points, and are connected with DS-3 or faster links. See http://www.boardwatch.com/ISP/backbone.html.

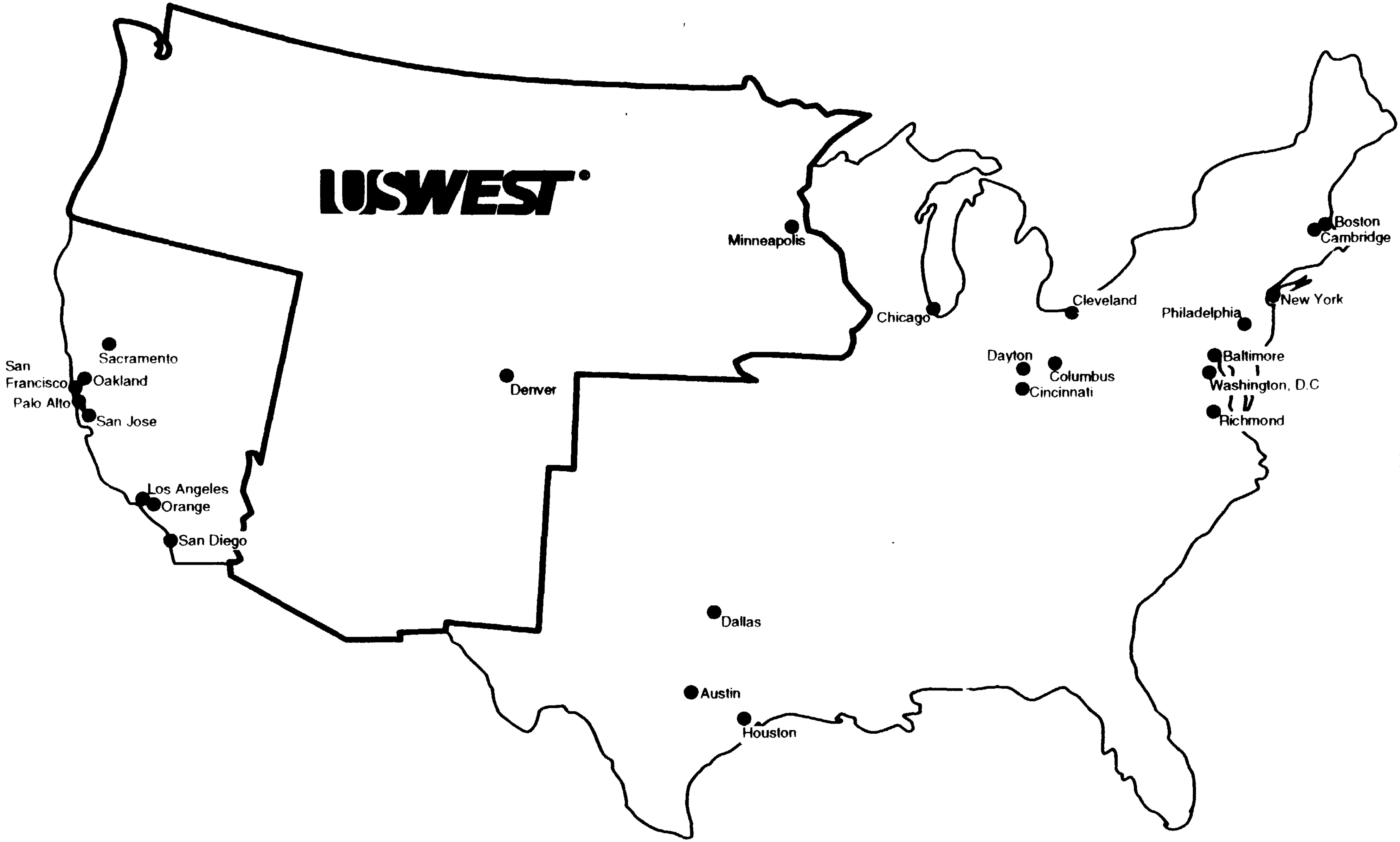
[6/] There are a number of smaller nationwide backbone networks in addition to the ones listed. To the extent that these smaller providers operate high-speed PoPs in U S WEST's (continued...)

ILLUSTRATION 1

PSINet
45 Mbps DS3 Backbone Cities

Source: Boardwatch Magazine (2/98)

ILLUSTRATION 2



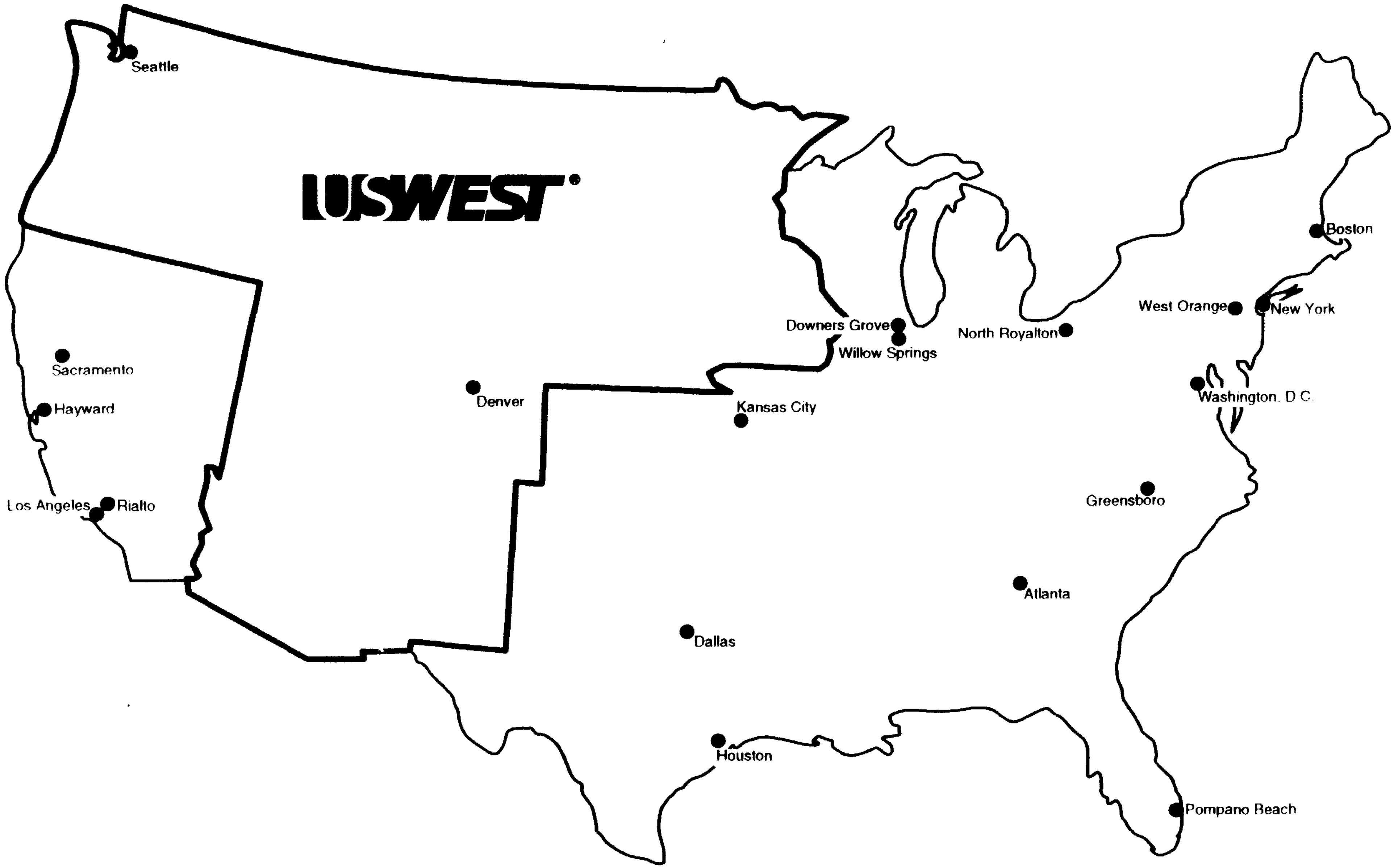
GTE Internetworking/BBN Planet
45 Mbps DS3 Backbone Cities

Source: Boardwatch Magazine (2.98)

ILLUSTRATION 3

Worldcom, Inc./UUNET
45 Mbps DS3 Backbone Cities

Source: Boardwatch Magazine (2-98)



MCI – DS3 and Above Backbone Cities

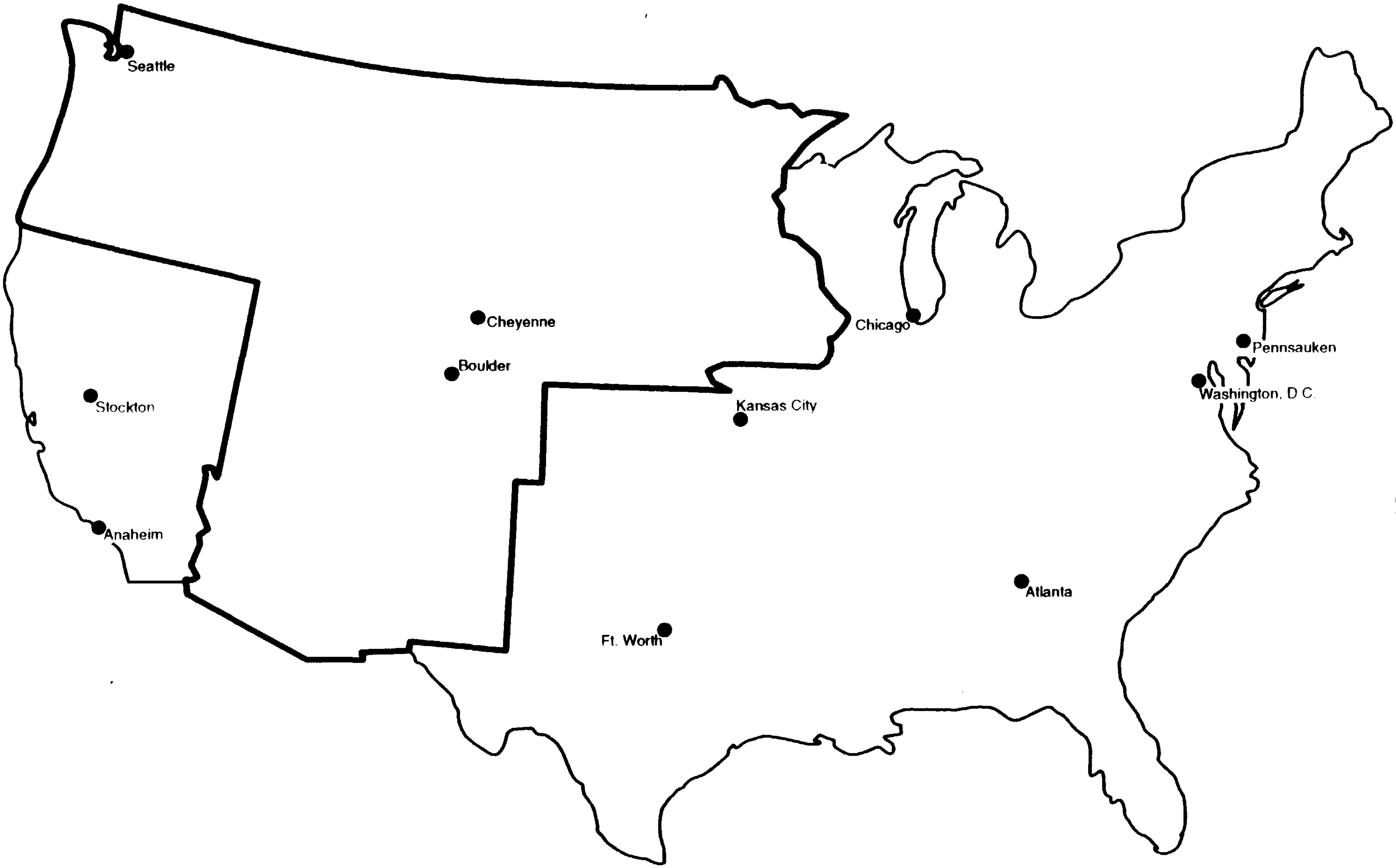
Source: Boardwatch Magazine (2-98)

ILLUSTRATION 5

DIGEX – 45 Mbps DS-3 Backbone Cities

Source Boardwatch Magazine (2-98)

ILLUSTRATION 6



Sprint IP Services
45 Mbps DS3 Backbone Cities

Source: Boardwatch Magazine (2-98)

ILLUSTRATION 7

AT&T
45 Mbps DS3 IP Backbone Cities

Source: Boardwatch Magazine (2/98)

of high-speed PoPs in U S WEST's region, leaving most of the fourteen-state region without high-speed service. Illustration 8 collects the largest seven networks on a single map, listing the number of national backbone providers serving each city with a DS-3 or faster PoP. Looking at this deployment LATA by LATA, as Illustration 9 does, demonstrates just how poorly the current backbone architecture serves rural America. Even when all thirty-eight national backbone providers for which there is publicly available information are considered, only nine of U S WEST's twenty-seven LATAs are served by more than one high-speed PoP, and seventeen of the twenty-seven are not served at all.[7]

Unlike the larger cities shown on the maps, smaller communities in U S WEST's region are connected to the internet by slower links, typically 56 kilobit-per-second or DS-1 (1.54 megabits-per-second) lines. In addition, they are connected into the backbone lower in the hierarchy, meaning that they have more "hops" to the high-speed links of the internet, and their traffic is aggregated with proportionately more traffic from other sources than is the case higher in the hierarchy. Illustrations 10 and 11 show how an ISP in a large city such as Denver might be connected to the internet, and how this compares to the access that an ISP in a smaller city such as Sioux Falls, South Dakota would have. The ISP in Denver would almost surely be

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[6] (...continued)
region, however, they deploy them (with two exceptions) in the same large cities served by the biggest providers. The smaller networks do operate one additional high-speed PoP in Tacoma, Washington and another one in Santa Fe, New Mexico.

[7] If anything, Illustration 9 exaggerates the availability of high-speed links in smaller communities because U S WEST's LATAs are so large, sometimes covering entire states. For example, there is only one high-speed national backbone PoP in all of Wyoming (in Cheyenne); yet, because Wyoming is a single-LATA state, the map depicts the entire state as "served."

ILLUSTRATION 8

Number and Location of AT&T, DIGEX, GTE/BBN Planet, PSINet, Sprint IP Services, MCI and Worldcom/UUNET DS3 Backbone Cities

Source: Boardwatch Magazine (2-98)

Internet Sites in USW Territory
(DS3 or Higher)

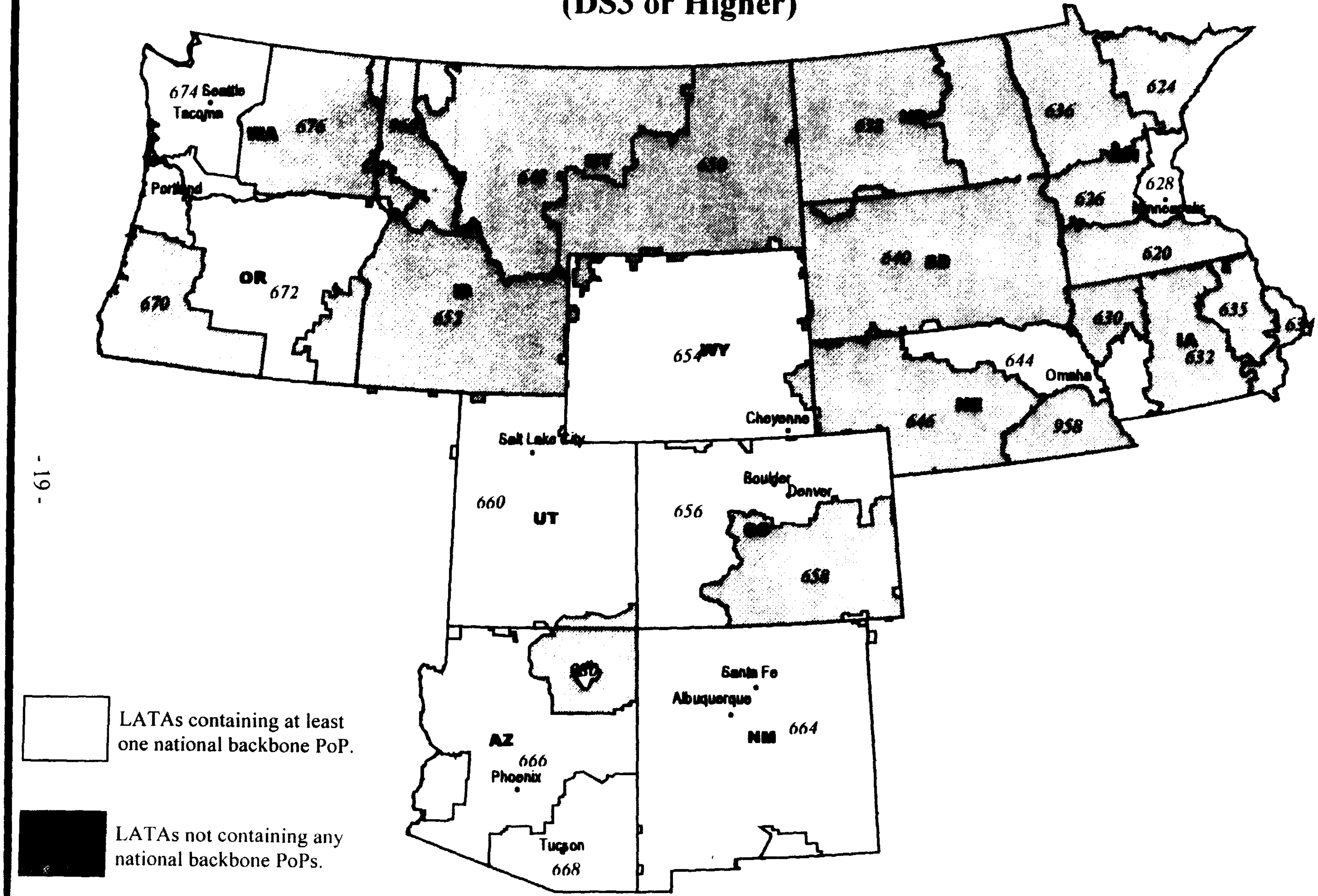
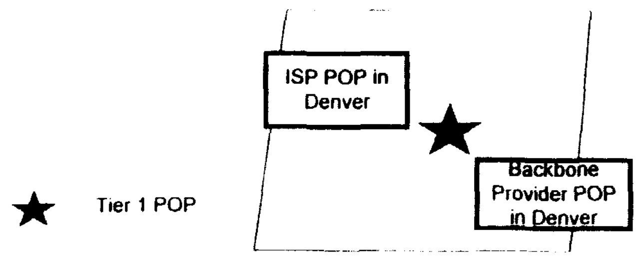


ILLUSTRATION 9

Internet Access

Scenario # 1 : Internet Access in Larger Market

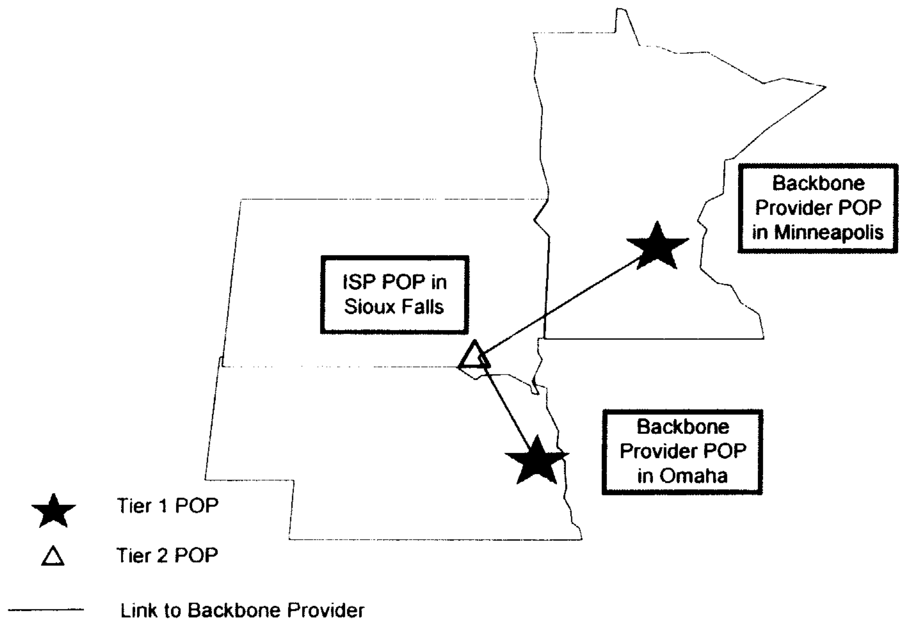


LOWER COSTS: Minimal if any additional facilities charge from ISP POP to backbone provider POP.

FEWER LIMITATIONS ON SERVICE: DS3 or higher capacity link availability to Internet backbone and more redundancy in the network.

Internet Access

Scenario # 2 : Internet Access in Smaller Market



HIGHER COSTS: Significant facility charges from Sioux Falls to Omaha (184 miles) or from Sioux Falls to Minneapolis (270 miles). The DS1 backhaul charges can be in excess of $1300 per month while DS3 backhaul charges can be in excess of $22,000 per month. Interlata relief would enable US WEST to eliminate these backhaul charges.

LIMITATIONS ON SERVICE: Even DSL customers may experience congestion and bottlenecks to the Internet over fractional DS1 lines and are vulnerable to single points of network failure.

ILLUSTRATION 11

located near at least one of the fourteen competing high-speed PoPs deployed in that city, and would have to pay for transport of its traffic over only a minimal distance to reach a DS-3 or faster connection. But to reach the higher levels of the backbone, the ISP in Sioux Falls would have to pay a remote or regional provider to carry (or "backhaul") its traffic to the nearest high-speed PoPs in Omaha, Nebraska (180 miles away) or Minneapolis (270 miles away). The only available and affordable link may be a DS-1 or fractional DS-1, and the ISP will likely find its traffic aggregated with other parties' traffic over these low-bandwidth links, a process over which it has no control.

Bell Atlantic has already demonstrated that there is significant congestion even at the highest levels (and fastest links) of the internet backbone, with the effect that the nationwide average speed for data transmission on the internet is only 40 kilobits per second.[8/] Rural subscribers and ISPs face additional chokepoints that slow this traffic even more. Their traffic is aggregated and routed to low-speed PoPs on the backbone. Whereas subscribers in large urban areas can connect to multiple and redundant PoPs, smaller communities are generally served by only a single PoP, and congestion or a technical failure at this PoP will effectively cut them off from the internet entirely. In addition, because rural subscribers and ISPs connect to the backbone lower in the hierarchy, their connections are of lower quality and more prone to congestion than similar connections in urban areas.

8/ See White Paper, attached to Petition of Bell Atlantic Corporation for Relief from Barriers to Deployment of Advanced Telecommunications Services, at 21-27, CC No. 98-11 (filed Jan. 26, 1998)

Small-city and rural backbone connections are not only of poorer quality than their urban counterparts, but also far more expensive. On top of their normal monthly charges for access to the internet, ISPs must pay distance-sensitive charges ("backhauling charges") to transport their data to a backbone provider's PoP. If the ISP is located in a city with a PoP (as is the Denver ISP depicted in Illustration 10), these backhauling charges will be minimal. But the charges can be overwhelming for ISPs in smaller cities and rural areas. As noted above, an ISP in Sioux Falls, South Dakota (Illustration 11) must pay to haul its traffic either 180 miles to Digex's DS-3 PoP in Omaha or 270 miles to the UUNet or GTE PoPs in Minneapolis. A DS-1 link over the shorter route will cost the ISP more than $1,300 each month, and the cost will jump to over $22,000 per month for a DS-3 link.[9] The expense of backhauling itself exacerbates network congestion problems: ISPs are driven to minimize backhauling costs by using the slowest links they can (DS-1s and fractional DS-1s) to connect to the backbone provider's PoP.

The lack of adequate backbone in smaller and rural communities stunts the deployment of advanced communications services and technologies to these areas. An ISP in a smaller market cannot offer its subscribers sophisticated information services if its only affordable connection to the internet is a fractional DS-1 that is continuously congested and becomes inoperable with every network failure at the sole PoP serving the market. Similarly, there is no point in rolling out high-bandwidth transmission technologies, such as digital subscriber lines, to local exchange customers in these smaller markets; chokepoints on the

[9] As explained in greater detail below, allowing U S WEST to deploy a national internet backbone with a high-speed PoP in Sioux Falls would enable the ISP to avoid paying these backhauling charges.

backbone make it impossible for these customers to take advantage of the megabit speeds that the high-bandwidth technologies would offer. Indeed, deploying high-speed technologies at the local level in these markets would only make matters worse by funneling greater volumes of data traffic — from 256 kilobits per second to seven megabits per second for each digital-subscriber-line customer — to the already choked backbone.

Digital Subscriber Lines and Smaller Communities

Digital subscriber line technologies, known generically as "xDSL," use customers' existing copper loops to provide high-speed data transmission without interfering with the carriage of voice. U S WEST currently offers one form of this technology — rate-adaptive asymmetric digital subscriber lines, or "RADSL" — under the MegaBit Services brand name. A MegaBit customer uses a special modem that creates a data channel on the loop apart from the existing voice channel. The customer's loop is connected to a second modem in the central office. The second modem sits in a shelf called a digital subscriber line access multiplexer (or "DSLAM") that directs the voice traffic to the ordinary circuit-switched network and routes the data channel to a packet-switched network. In the packet-switched network, data is routed between ATM or frame relay switches connected to each other by private lines, and then to a business site or to an ISP for routing to the internet. With MegaBit Service, a customer's voice channel always remains operational even if the data channel is disrupted.

As noted above, U S WEST is currently engaged in the most aggressive deployment of digital subscriber line services in the country, having committed to providing its

MegaBit Service within the next few months in over forty cities in all fourteen of its states.[10] U S WEST is committed to expanding this roll-out to smaller communities where it is economically feasible to do so. At the present time, roughly half of the customer loops in its service region are capable of being used for xDSL; the remainder are either served with multiplexing equipment that interferes with xDSL transmission (approximately 35%) or are too long to carry the partitioned signals without interference (approximately 15%). U S WEST's vendors are now developing xDSL equipment that is compatible with fiber-based loop multiplexing facilities and that can serve longer loop lengths; as a result, the portion of U S WEST's customers capable of being served with xDSL will increase over time.

Like many advanced communications and information services, xDSL is more difficult to deploy in less densely populated areas. A carrier recovers the costs of xDSL central-office facilities (such as DSLAMs, DS-3 links, and packet switches) from customers' use of those facilities, and central offices in less densely populated areas serve fewer customers. Rural areas also are more likely to have the longer loops and multiplexing equipment that make the deployment of xDSL services more expensive or perhaps prevent deployment altogether. Given the inherent difficulties of providing xDSL in these areas, introducing small efficiencies or inefficiencies into the deployment can make the difference between whether providing the service in a given market is economic or uneconomic.

U S WEST believes there is strong demand for MegaBit and other xDSL services in its region. These services can deliver enormous improvements in transmission speed at a price

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[10] Only one other RBOC (Ameritech) has an xDSL tariff in place, and only in one state.

point that consumers can afford: $40 per month, with a nonrecurring charge of $145. U S WEST expects to have over 100,000 MegaBit Service subscribers in its region by the end of 1998. In addition to meeting pent-up customer demand for high-bandwidth services, U S WEST has strong network incentives to accelerate MegaBit Service deployment as much as feasible. As U S WEST has documented, and as the Commission recognizes, increases in data traffic are causing serious congestion on the circuit-switched voice network, since data calls typically have much greater holding times than the voice calls for which the network was designed.[11] MegaBit Service alleviates this congestion by offloading data traffic to a separate packet-switched network before it encounters any circuit switch. Thus, in addition to providing customers with broadband services, U S WEST's MegaBit offerings contribute directly to the overall efficiency of the circuit-switched network.

Regulatory Barriers Preventing Deployment of these Services to Smaller Communities

As the previous sections demonstrate, low population densities make it more difficult for carriers to deploy internet backbone and xDSL technologies to residential and small-business customers in smaller and rural markets, and these areas accordingly fall well behind

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[11] See Comments of U S WEST, Inc. in Response to Notice of Inquiry Concerning Information Service Providers, CC Dkt. Nos. 96-262, 94-1, 91-213, and 96-263, filed on March 24, 1997. These comments contained a study demonstrating that the average length of a call to an ISP was 14 minutes, compared to four minutes for the average residential voice call and two minutes for the average business voice call. The study showed that over 40% of ISP calls were longer than five minutes, compared to 16% of residential voice calls and 8% of business calls. Moreover, because the study was completed before the proliferation of ISP service plans offering subscribers unlimited internet use for a flat monthly fee, it clearly underestimates the impact of ISP calls on the circuit-switched voice network; it is universally acknowledged that these unlimited-use, flat-rated plans have dramatically increased subscribers' use of the internet.

their larger counterparts. U S WEST is the best-positioned carrier in its region to correct these deficits. However, federal regulatory barriers either prevent U S WEST outright from stepping into the breach or force it to structure the needed services in a way that makes their deployment uneconomic.

1. High-speed data networks and the ban on interLATA data carriage. The ban on in-region, interLATA data transport makes it simply impossible for U S WEST to build an internet backbone (or any other kind of regional high-speed data network) in its fourteen states. There is no market for an "intraLATA internet backbone"; indeed, the term is an oxymoron. Illustration 12 shows how U S WEST currently configures its in- and out-of-region data networks, and the effect of the ban on in-region interLATA data carriage is obvious. U S WEST cannot connect the various PoPs in its region because they are in different LATAs. For the same reason, it cannot deploy the backbone necessary to provide adequate service to the smaller markets that are more distant from these PoPs. These limitations leave these communities dependent, for the most part, on single PoPs with no back-up; as a result, they can be cut off from the internet entirely by a single network failure. Adding insult to injury, ISPs in these communities must pay more than their urban counterparts for connections that are inferior, since they pay distance-sensitive charges for backhaul to the PoP.

Illustration 13 depicts the type of national network that U S WEST could and would build if !nterACT were allowed to carry data across LATA boundaries and connect its various in-region and out-of-region networks. Building this backbone would increase the quality of internet services available to rural subscribers, and it would enable ISPs in these smaller

Current !NTERACT National Network Map

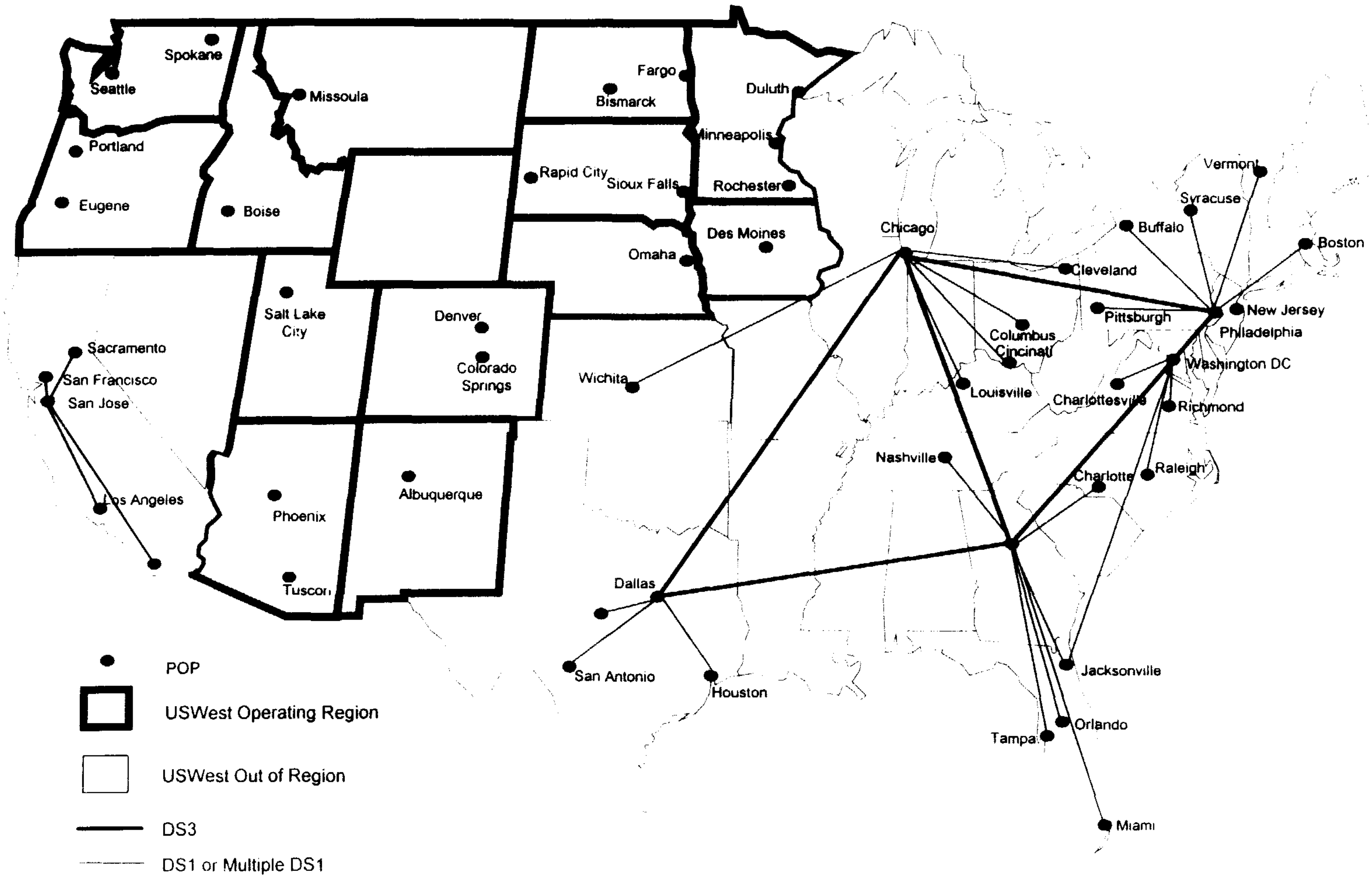

ILLUSTRATION 12

Proposed !NTERACT Infrastructure

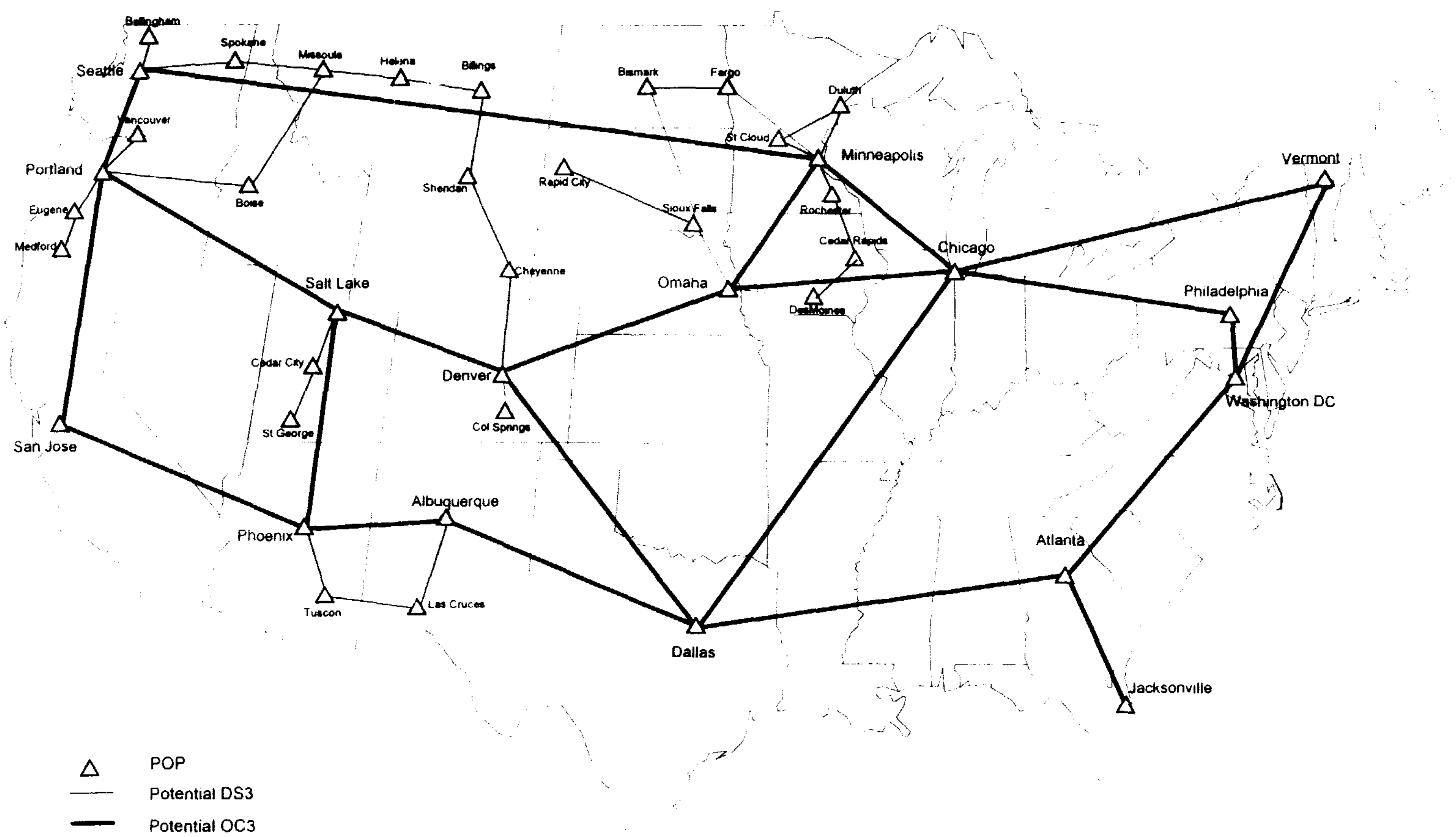

ILLUSTRATION 13

markets to expand dramatically the services they could offer. U S WEST could monitor the network from end to end, allowing for better management of traffic loads and more efficient network maintenance. U S WEST's entry into this market would increase redundancy in the backbone, preventing network failures from severing communities' connections to the information superhighway. Most importantly, as this diagram illustrates, U S WEST would be able to deploy greater bandwidth to many additional smaller markets, alleviating the network congestion rural ISPs and subscribers face, decreasing the costs of their connections to the internet by reducing the need for backhauling, and improving the quality of their connections by allowing them to reach the upper levels of the internet hierarchy in fewer hops. Put very simply, regulatory relief would enable the Sioux Falls ISP in Illustration 11 to operate like the ISP in Denver in Illustration 10.[12/]

But U S WEST can build this national backbone only if it is permitted to transport data across LATA boundaries; otherwise, despite the great pent-up demand for this and other data networking services, U S WEST is limited to an in-region, non-interconnected network and the wholly separate out-of-region networks depicted in Illustration 12. The ban on interLATA data carriage has forced U S WEST to turn down many requests for assistance from educational institutions, independent ISPs, and other potential clients. In March 1997, for example, a coalition of universities and government institutions — including Arizona State University, the Colorado School of Mines, Colorado State University, the Universities of Colorado at Boulder

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12/ In addition, allowing U S WEST to provide cell-switched and frame relay services across LATA boundaries would sharpen U S WEST's incentives to deploy bandwidth even further by making it easier to aggregate the critical masses of data traffic that make deployment in smaller markets economic.

and Denver, the National Center for Atmospheric Research, the University of New Mexico, the University of Utah, and Utah State University — asked U S WEST to submit a proposal to build a high-speed cell-relay network connecting these institutions, to be known as "Westnet2." Because of the interLATA restriction, U S WEST could not offer to build an integrated wide-area network as the Westnet2 members had hoped; instead, it could offer only a series of smaller ATM networks connected by cell-relay links purchased from an interexchange carrier.[13] While the coalition members were extremely interested in having U S WEST build Westnet2, given that the company had already built many of the intraLATA ATM networks these institutions were currently using, they were reluctant to proceed and ultimately put the project on hold; U S WEST's having to rely on a second carrier to provide the interLATA links of the network meant that it could not guarantee the reliability of those links and introduced too many contingencies into the project. U S WEST will never be able to build the type of networks that these institutions need so long as the ban on interLATA service applies to data networking services.

2. MegaBit Service and the ban on interLATA data carriage. The ban on in-region, interLATA data carriage similarly hampers the efficient provision of xDSL services such as MegaBit, making it prohibitively expensive for U S WEST to deploy these technologies in rural areas. The central office equipment used to provide MegaBit Service is expensive: a basic, 128-user DSLAM costs approximately $73,000 installed (and several might be necessary), an installed ATM switching system costs approximately $350,000, and the DS-3 networking needed

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[13] Ironically, U S WEST would have been allowed to build a region-wide network for the coalition (albeit only an internet backbone network) had its members been elementary or secondary schools instead of universities. See 47 U.S.C. § 271(g)(2).

to connect the central office with other central offices can cost several hundred thousand dollars, depending on how remote the office is and what facilities have already been deployed. The costs of deploying xDSL services decrease significantly (and the number of central offices in which customer demand reaches the break-even point accordingly increases) to the extent that central offices can share equipment. In particular, if U S WEST could aggregate traffic from multiple central offices in different LATAs to centralized high-capacity ATM switches, it could reduce the number of switches it would have to deploy and decrease the costs of rolling out MegaBit Services to these central offices.[14/]

Illustration 14 demonstrates how this might be done. The DSLAMs in each central office supporting MegaBit Services would be connected with a DS-3 to the nearest regional ATM switch, which might be in a different LATA. (For clarity, the central-office connections are not shown in the illustrations.) The ATM switches would be connected to one another with DS-3, OC-3, or other high-capacity links. Data traffic could be aggregated and handed off to ISPs or corporate intranets at single, efficient host connections.

But because U S WEST is not allowed to aggregate data traffic from central offices in different LATAs, it must build a redundant set of facilities in each one, as shown in Illustration 15. In this configuration, each central office must connect to an ATM switch located in the same LATA. Each redundant ATM switching system that U S WEST must install adds $350,000 to the costs that must be recovered from small- and rural-market customers before

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14/ The availability of high-capacity ATM switches allows for significant economies of scale in cell-switched networks. For example, U S WEST's out-of-region ATM network, when complete, will need only eight to ten switches to serve the top eighty out-of-region markets.